

# *A/C Integration of the Latest Technology*



## Certification Challenges

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## Overview

- New Technologies for Safety and Utility
- Product Development
  - Human Factors Considerations
  - Industry Groups (RTCA, SAE, etc.)
  - Legal Issues (Patents)
  - International Certification (JAA, etc.)
- Certification Paths
- Example Demonstration

## Market Pressures

- As new technologies become available in the commercial market place, there are tremendous pressures to bring them quickly into the aircraft realm.
  - Internet Access, Office-in-the-Sky, Sat TV, In-Flight Entertainment, etc.
  - Cockpit Display Technologies, TAWS, GPS, Electronic charts, Integrated Avionics, etc.

## Realities

- Most commercial & consumer products are not designed with aircraft use in mind
  - DO-160 Environmental Categories
  - Software Criticality
  - Failure Modes, Reliability
  - Human Factors
- Often, the technology arrives before there is a certification basis for airborne use (i.e. RTCA or SAE MOPS and TSO).

## New Technology

- Products that have not been previously certified, such as:
  - Satellite Communication / TV
  - EGPWS (prior to TSO C-151a)
  - Unique TAWS displays
  - Electronic charting system (paperless cockpit)
  - GPS Landing System
  - Enhanced Vision

## New Technology

- A new implementation of an existing technology
  - Flat Panel Display Technology for PFD, ND, MFD, CDU, IVSI, etc.
  - Highly Integrated Avionics Suites Using Very High Speed Data Buses (Ethernet, Firewire, USB, etc.)

## Product Development

- GET FAA INVOLVEMENT EARLY IN THE PROJECT!
- Discuss new and novel aspects
  - Judgement call by FAA Project team
  - No hard and fast rules
  - Can have significant impact on system design
  - Don't let this happen late in the process
  - Need FAA written consensus
  - Can require multiple demonstrations / evolutions of technology

## Human Factors

- Subjective evaluation of how equipment performs its intended function
- Ease of use / intuitive operation
- Not misleading
- Graceful failure modes
- Location of controls
- Use of colors, positions of controls / displays
- Multiplexing of display devices
- Pre-existing concepts / notions

## H/F Evaluations

- Will likely require multiple demonstrations
  - to multiple ACO representatives at multiple locations
  - to FAA Pilots, Engineers, AEG, NRS, Industry Pilots, etc.
  - FAA may provide questionnaires / surveys
  - FAA tabulate results of evaluations
  - FAA formulate position on certifiability
  - Applicant respond to issues
  - Applicant propose design changes
  - FAA review proposed changes
  - Applicant implements changes
  - Start over with evaluation

## Guidance Materials

- Burden on Applicant to research existing /draft guidance materials
  - Not necessarily regulatory documents, may be reference materials from RTCA, SAE, NASA working groups
  - Applicant should be attending Industry forums composing guidance materials
  - May have difficulty accessing some materials if not members of these groups
  - Meetings often International due to JAA & other countries' interests

## Patents

- Applicants must tiptoe carefully through this Minefield!
- DERs must maintain strict confidentiality when dealing with different manufacturers' proprietary data
- Regulatory material can infringe (for example, early GPWS)

## World Market Concerns

- Certification standards vary
- JAA, others may require additional features / functions
- Other certification agencies may want to do their own evaluations
- FAA acceptance is not a guarantee of acceptance in all countries

## Certification Paths

- Use “*The FAA and Industry Guide to Product Certification*” and FAA Order 8110.4B *Type Certification* as Guidance
- Decide on **TC/STC** and **TSO/PMA** path
  - TSO may not exist in many cases (e.g., SATCOM, data link, cabin entertainment, smoke detectors, cameras, EV, etc.)
  - In other cases, existing TSO does not cover added functionality.
- If TSO does not exist, must go STC/PMA route.

## TSO

- Covered in FAR Part 21, Subpart O.
- Preferred method to market a product.
- Aircraft independent.
- Relieves TC or STC applicant of having to take responsibility for appliance design data (DO-160D, DO-178B, manufacturing processes, etc.)
- Any additional functionality must be evaluated under STC process.

## STC/PMA

- If no TSO and MOPS exist, it is incumbent upon applicant to create a design data package with all the same elements – MOPS, DO-160 requirements, software documentation, system safety analysis, etc.
- Submit appliance design data along with installation data as part of TC/STC package.
- STC Guidance in AC 21-40, *Application Guide for Obtaining STC*

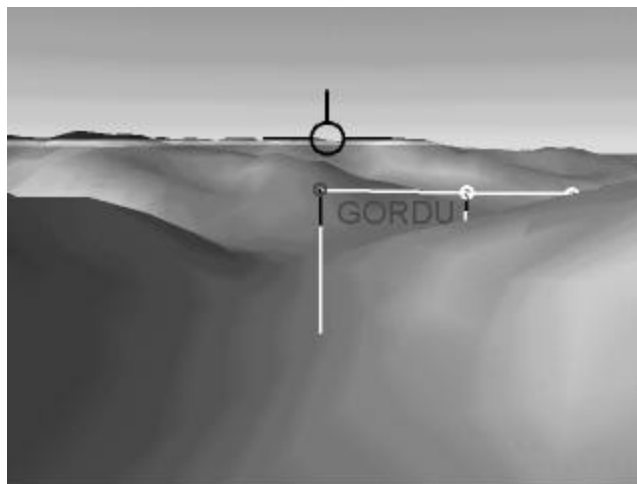
## STC/PMA

- All parts must be conformed
- FAA or DER approval and witnessing required for all testing phases
- Upon award of TC or STC, apply through MIDO for Parts Manufacturer Approval in accordance with Order 8110.42.
- PMA only covers same aircraft type as original TC/STC approval.

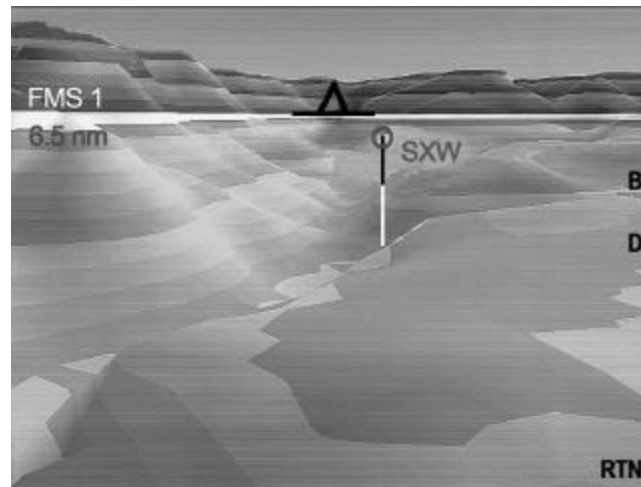
## Two Examples

- TAWS 3D and Profile Display Views
  - Numerous Human Factors Comments
  - 3D View Initially Deemed Too Compelling as Attitude Display. Had to degrade.
- Electronic Charting
  - Issues of Touch Screen Usability
  - Use of Windows NT Operating System
  - Mounting in Cockpit

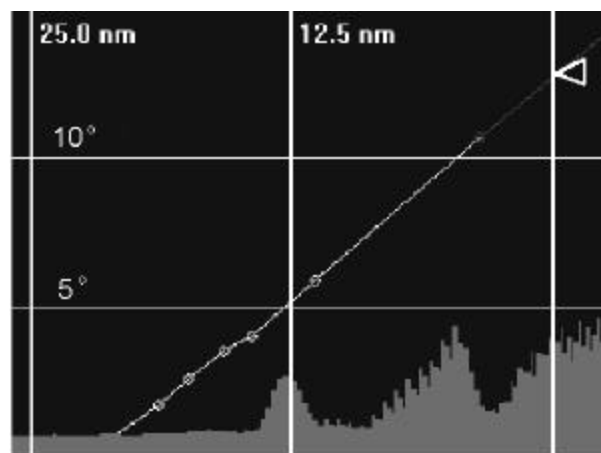
### Original TAWS 3D View



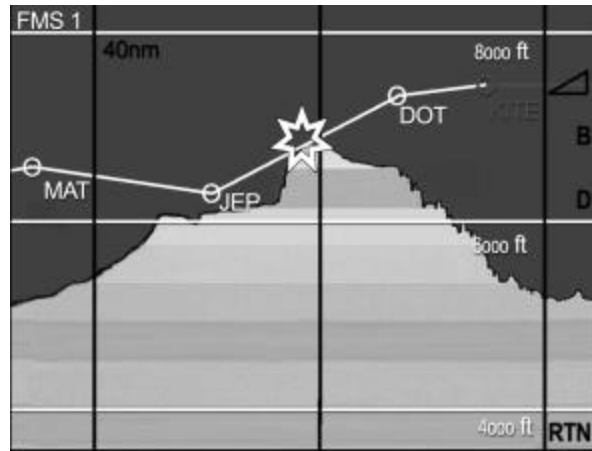
## Final 3D View



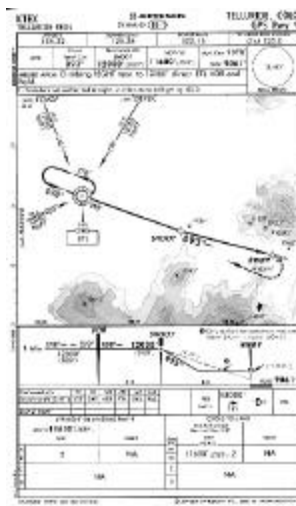
## Original Profile View



## Final Profile View



## TAWS Demo – Telluride, CO



Not for Navigation

## UCD System



## Universal Cockpit Display

- Use of COTS software
- Mitigation of NT operating system
- Human factors
  - Display location / Cockpit visibility
  - Chart readability
  - Touch-screen operation
  - Structural mounting issues

# Approach Charts



# Checklists

Check Before Engine Start		
APU	ON	+
EL. Hydr. Pumps 1B, 2B, 3B	CHECKED	+
EL. HYDR. PUMP 3A	ON	
BRAKE PRESSURE	CHECKED	Check
PARKING BRAKE	ON	
CHOCKS	REMOVED	Stop
GROUND SPOILERS	TEST / OFF	Stop
EMERGENCY LIGHTS	ARMED	Stop
CABIN PRESS SYSTEM	AUTO. RATE, ALT	Check
ADS and Windshield Heaters	CHECKED	Stop
Anti-Ice Panel	TESTED	Stop
Duct Monitor Loops	CHECKED BOTH	Stop
Bleed Air Leak Detect	TESTED	
Crew and Pax Oxygen	CHECKED	
Static Selectors	GUARDED	

## Conclusions

- Bringing a new technology to the aviation market can be challenging, costly, and time consuming. However, it is also extremely gratifying.
- Do your homework.
- Keep FAA involved at all times.

## Questions?

